



**Barcelona
Supercomputing
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Centro Nacional de Supercomputación



EXCELENCIA
SEVERO
OCHOA

Assessment of near-surface wind speeds from multiple reanalyses

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Many thanks to P.A. Bretonnière and M. Samsó



- Large scale deployment of renewable energy (RE)
- Integration in the electricity networks
- **Challenge** ➔ accurate forecast of future variability of the energy source

WHAT IS S2S4E?



S2S4E project (H2020) aims to provide **near-real time seasonal-to-subseasonal forecasts** to help RE producers and providers in the decision-making context. The main output of S2S4E will be a **Decision Support Tool** (DST). It will integrate for the first time S2S climate predictions with RE production and electricity demand.

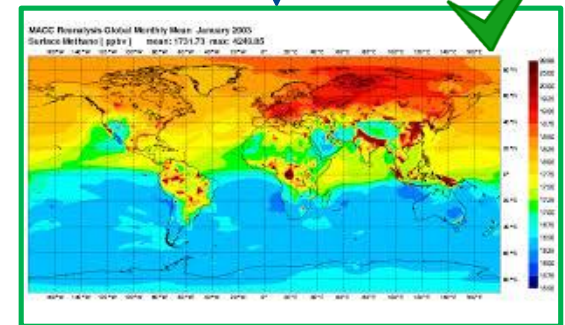
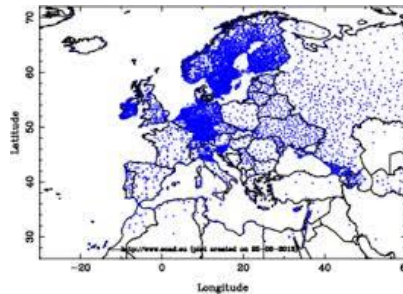
Improve quality of future predictions



Understand past variability



Observational datasets



OBJECTIVE

Analysis of the **uncertainty** related to different reanalysis datasets and select the source that better represents **wind speed variability**

HOW WILL WE DO THAT?

1. Intercomparison of different reanalysis datasets

Reanalysis	ERA5	ERA-Interim	JRA-55	MERRA-2	R1
Institution	ECMWF	ECMWF	JMA	NASA GMAO	NOAA/NCEP and NCAR
Resolution	~ 31 km	~ 80 km	~ 130 km	~ 52 km (lat) x 65 km (lon)	~ 207 km (lat) x 195 km (lon)
Period coverage	2000 to present	1979 to present	1958 to present	1980 to present	1948 to present

- Regrid to R1 grid (coarser grid)
- Common period coverage: 2000-2017
- Seasonal averages: DJF, MAM, JJA, SON

HOW WILL WE DO THAT?

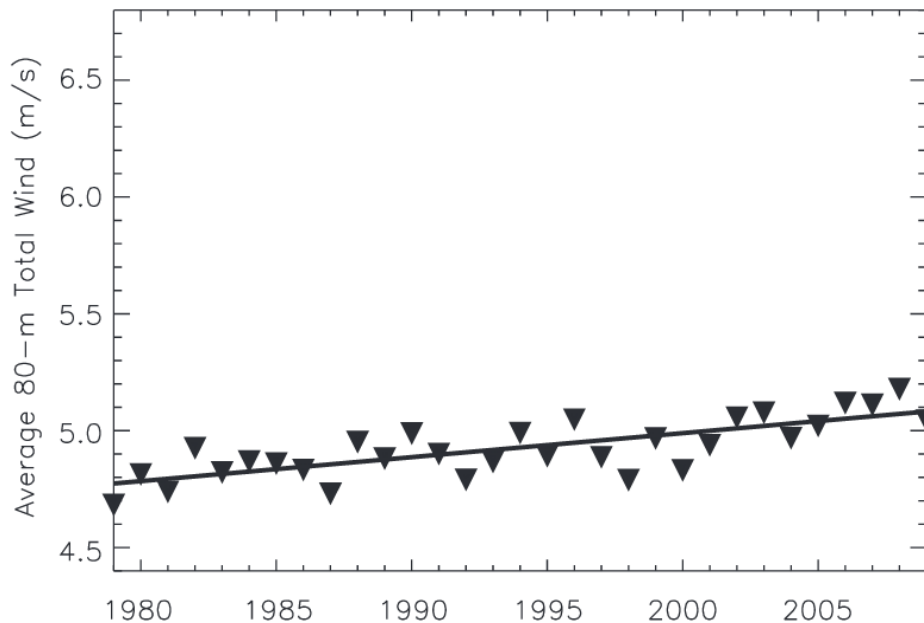
1. Intercomparison of different reanalysis datasets

- In terms of:
 - Climatology
 - Variability: interannual variability (IAV)
 - Long term linear trends

HOW WILL WE DO THAT?

1. Intercomparison of different reanalysis datasets

- In terms of:
 - Long term linear trends



$$WS = B_0 + B_1 t$$

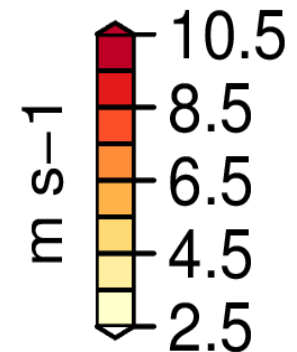
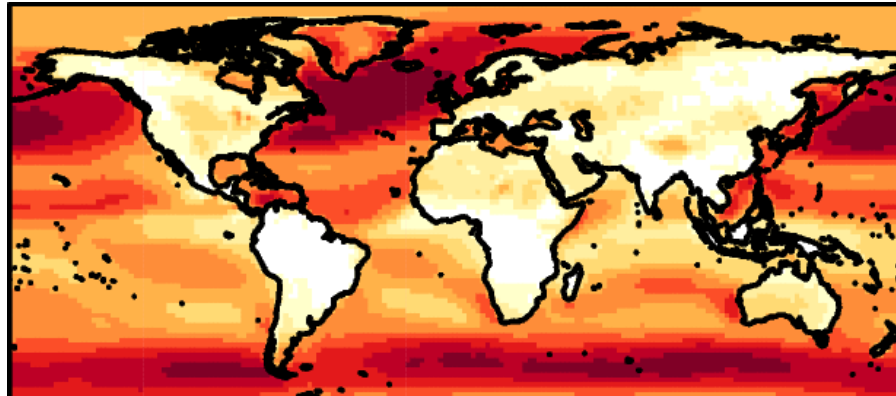
$t = \text{time}$

$B_1 = \text{linear rate of change}$

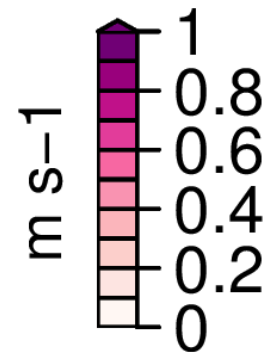
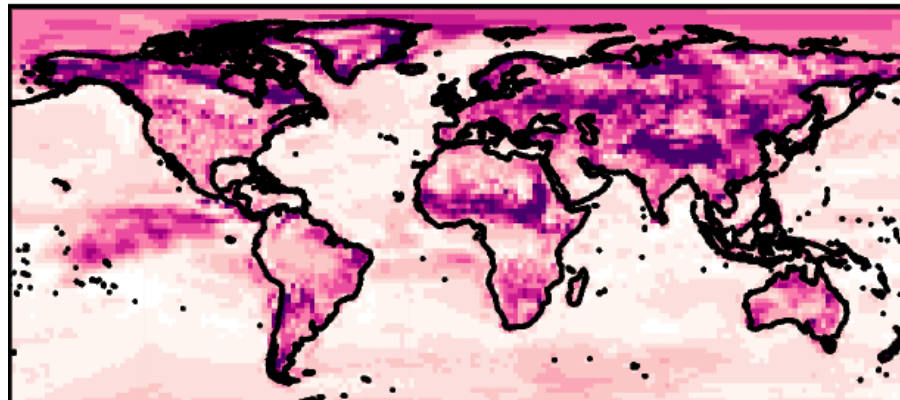
Source: Holt E., Wang J. Trends in wind speed at turbine height of 80 m over the contiguous united states using North American Regional Reanalysis (NARR). *Journal of Applied Meteorology and Climatology*, 2012. 51, 2188-2202

- Seasonal climatology for DJF. Period 2000-2017

Multimodel
mean (MM)



Multimodel
spread

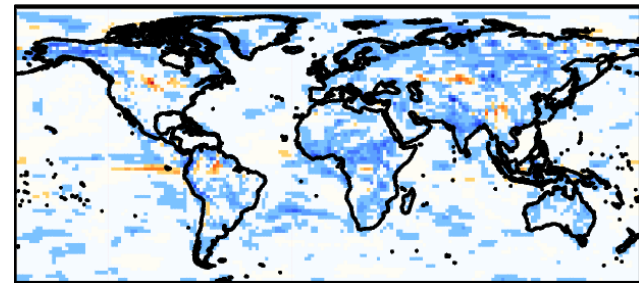
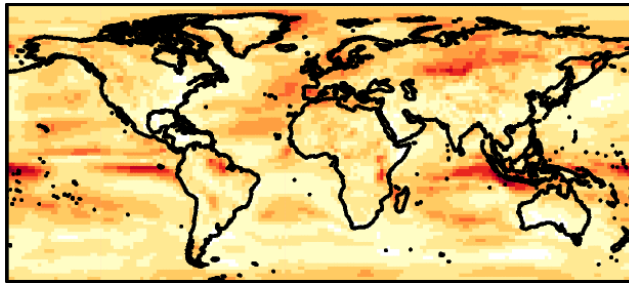
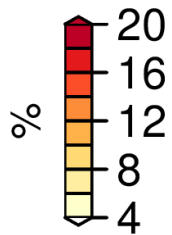


- MM



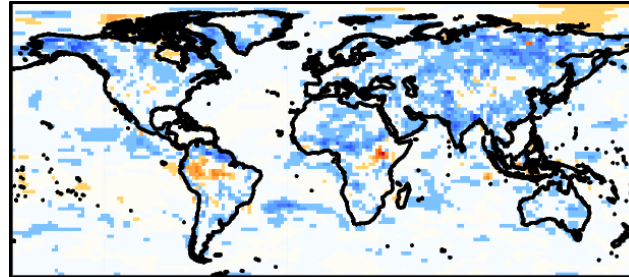
- Interannual variability for DJF. Period 2000-2017

MM

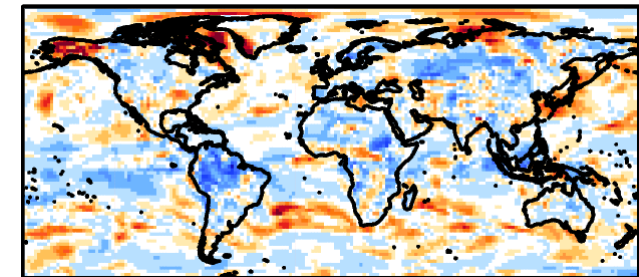


ERA5

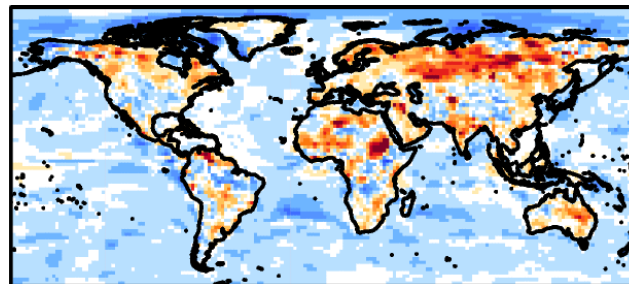
ERA-Interim



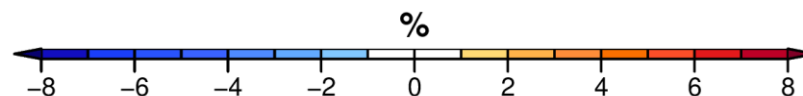
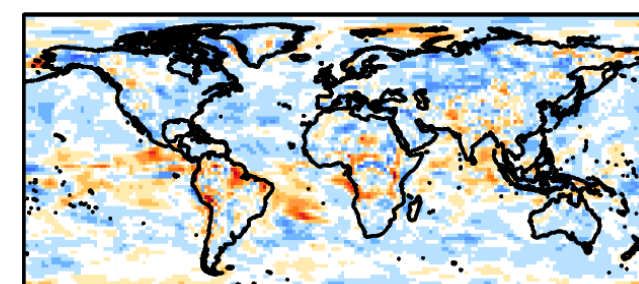
MERRA2



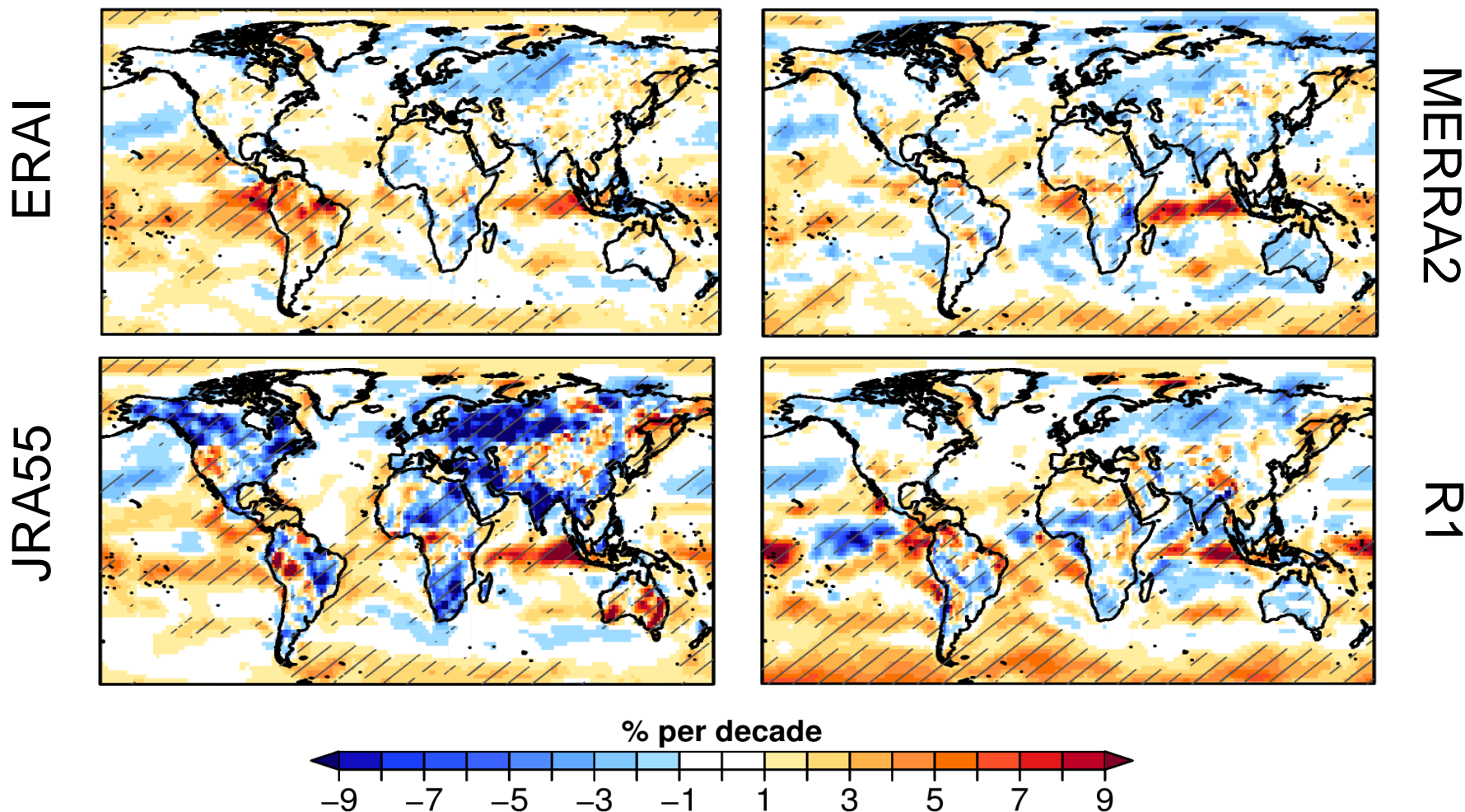
JRA55



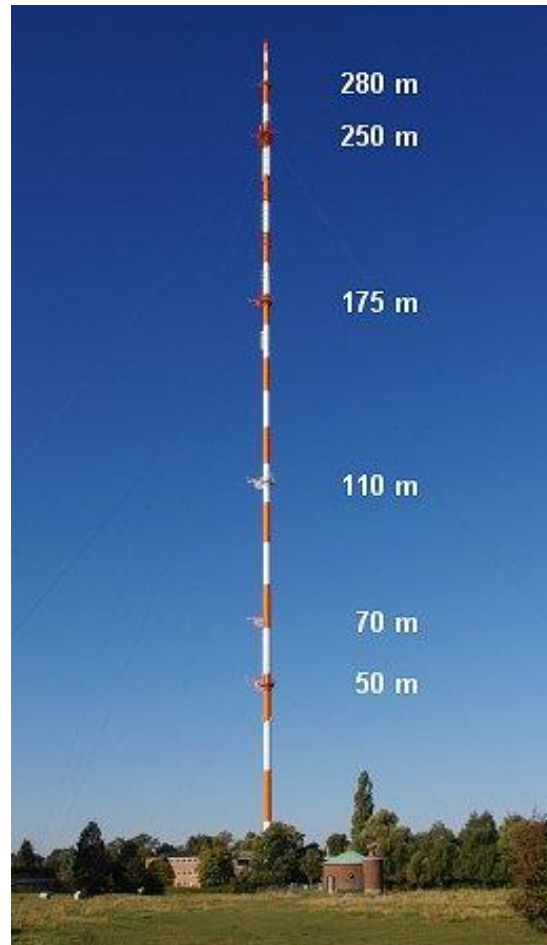
R1



- Linear trends¹ for DJF. Period 1980-2017

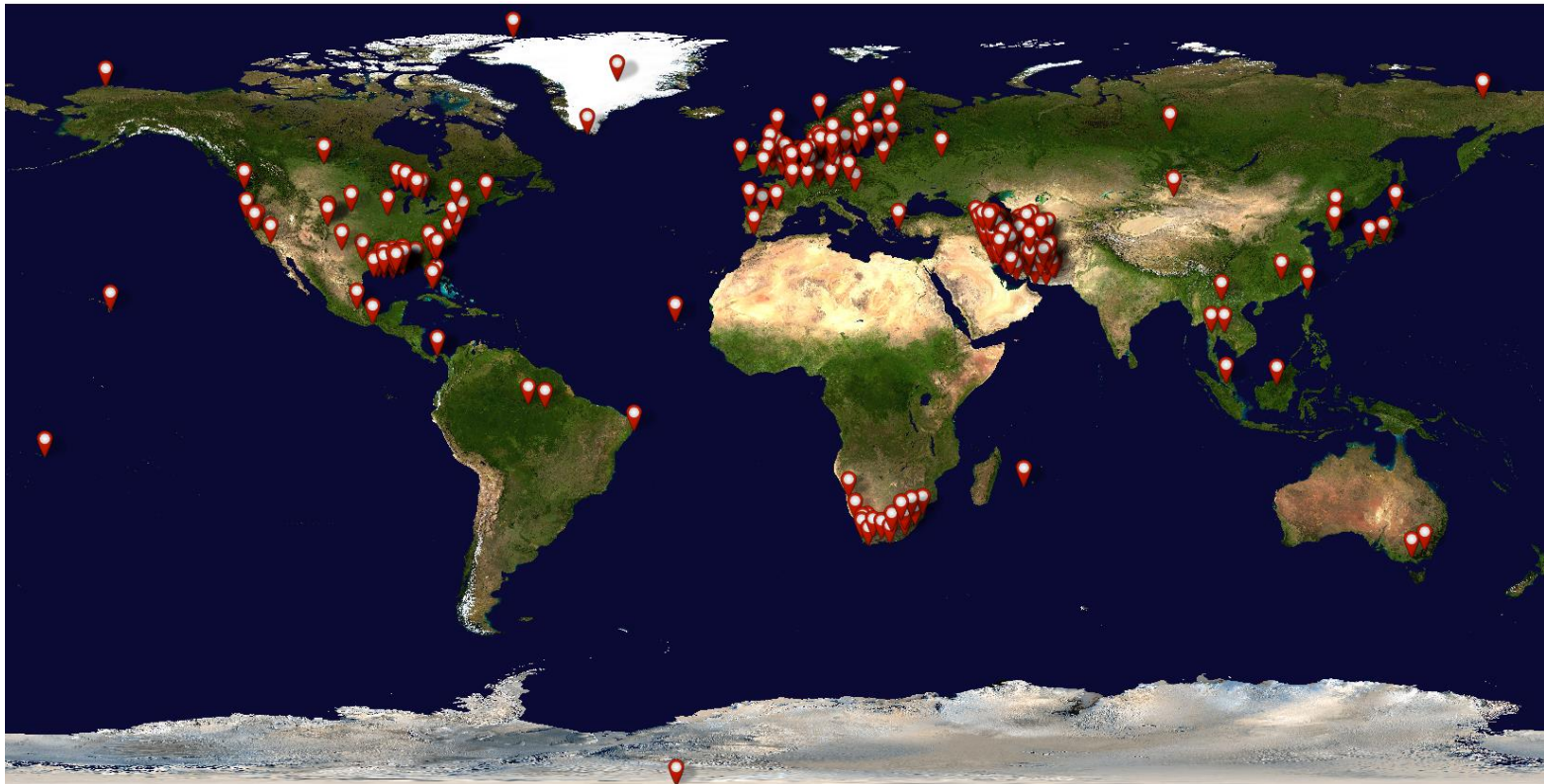


2. Comparison of reanalysis data with tall tower observations



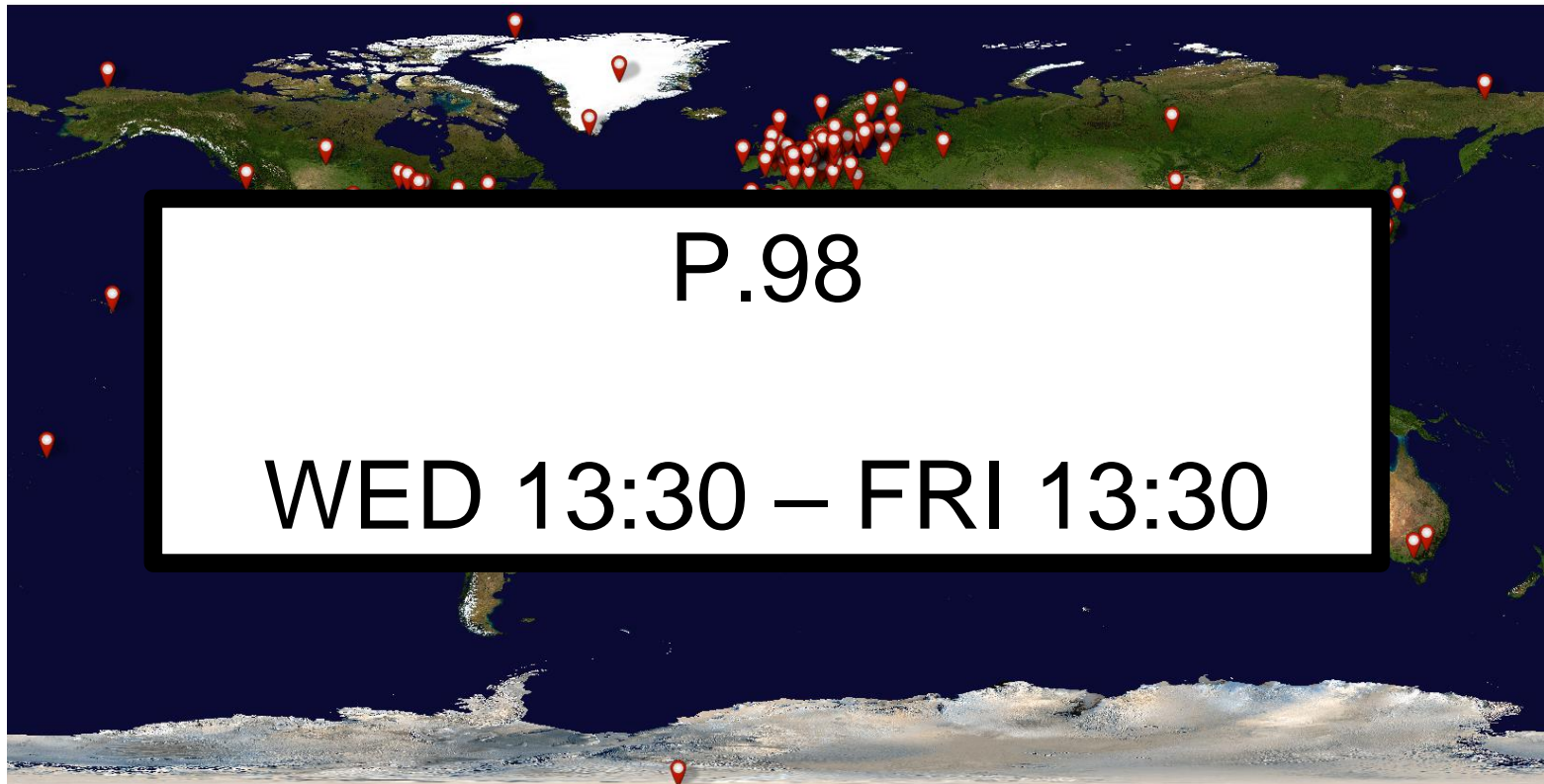
Hamburg University met mast, DE

2. Comparison of reanalysis data with tall tower observations



311 masts identified

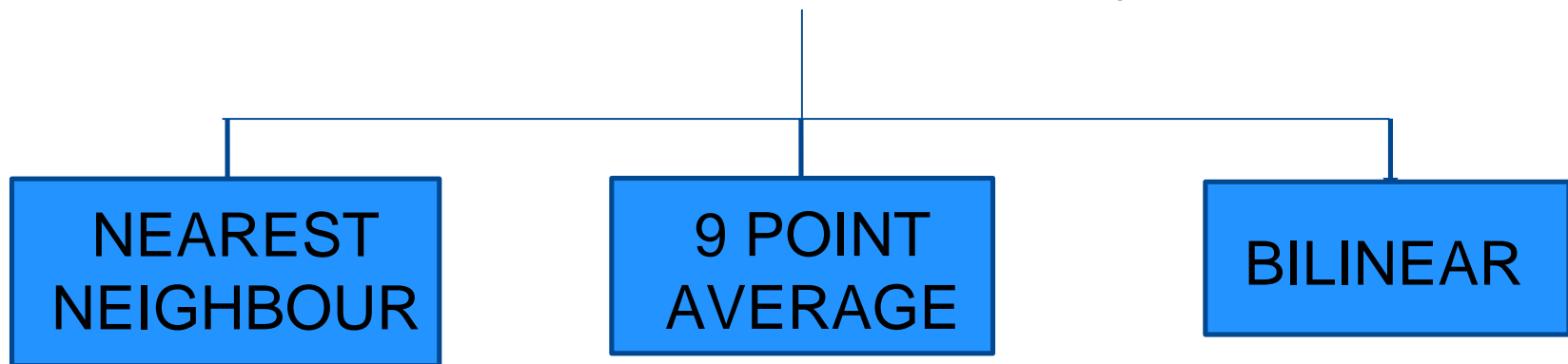
2. Comparison of reanalysis data with tall tower observations



311 masts identified

2. Comparison of reanalysis data with tall tower observations

- Model data is **interpolated spatially** to tower sites



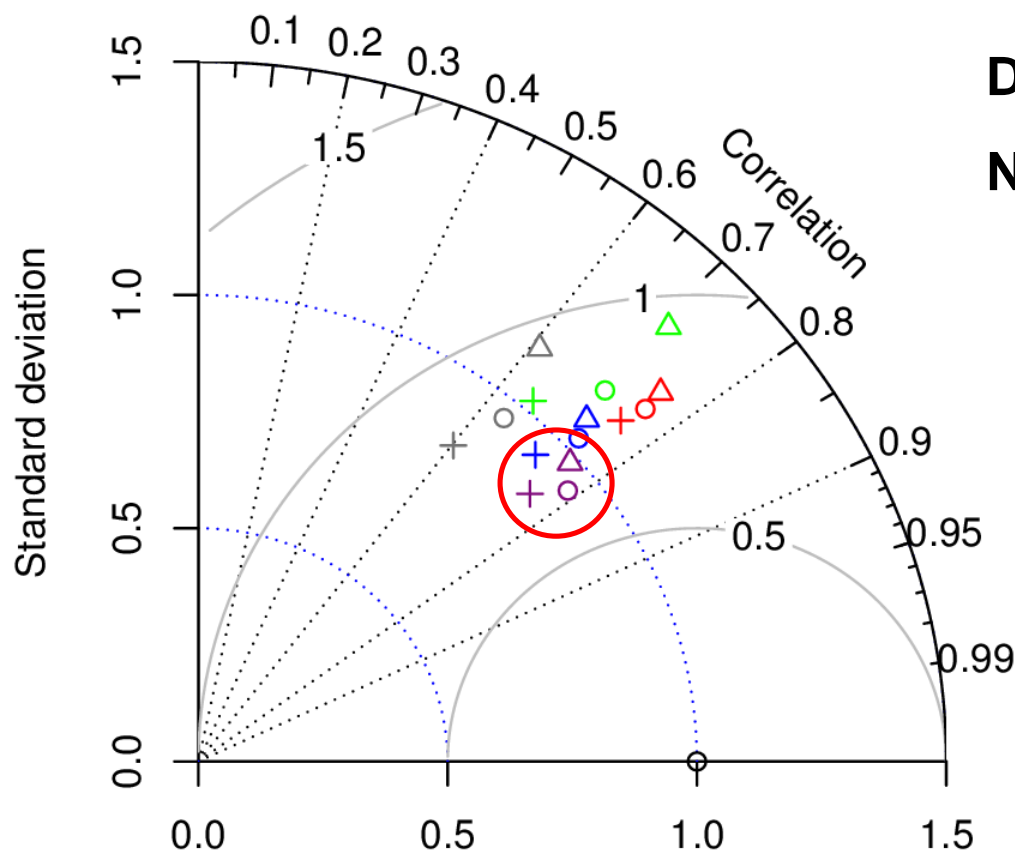
- Then, model data is **interpolated vertically** to tall tower measurement level

$$WS(h) = WS(h_{ref}) * \left(\frac{h}{h_{ref}} \right)^{\alpha}$$

$\alpha = 0.143$ for onshore towers

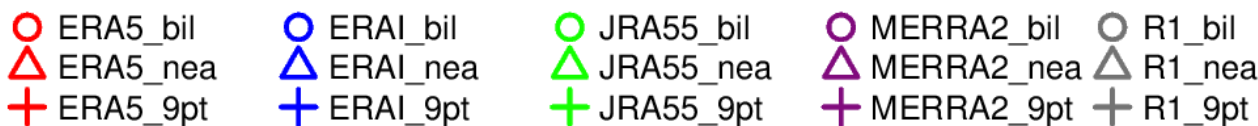
$\alpha = 0.11$ for offshore towers

- Different interpolation methods



Daily means

N = 213 sites

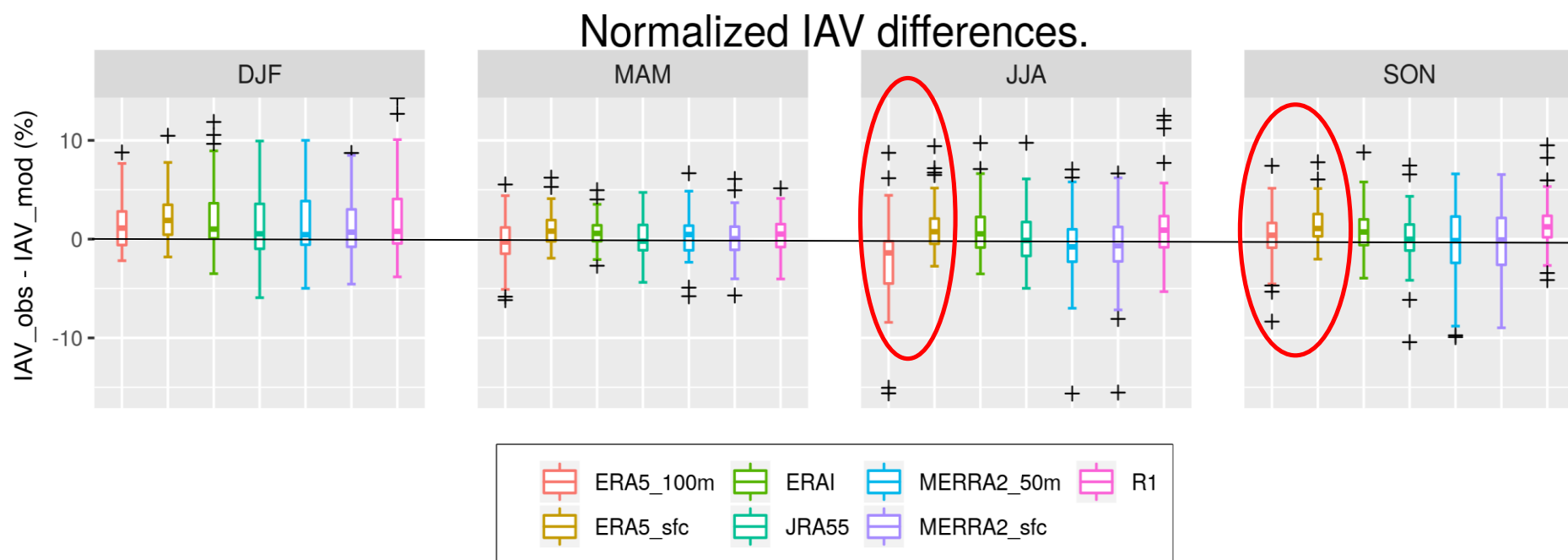


- Interannual variability**

Bilinear method

Seasonal means

POR > 4 years



- Several disagreements have been found among five modern reanalysis datasets, specially for continental regions
- The newly released European dataset ERA5 generally agrees with ERA-Interim
- Bilinear method performed better than the other considered interpolation approaches
- ERA5 performed better than the other datasets, particularly with the interpolation of surface winds.

FUTURE WORK

- Repeat the study for the common period 1980-2017 once ERA5 is completely released for this time coverage.

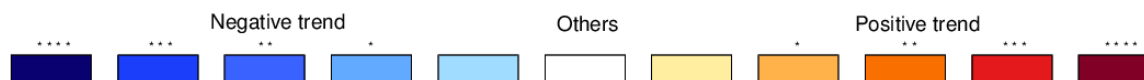
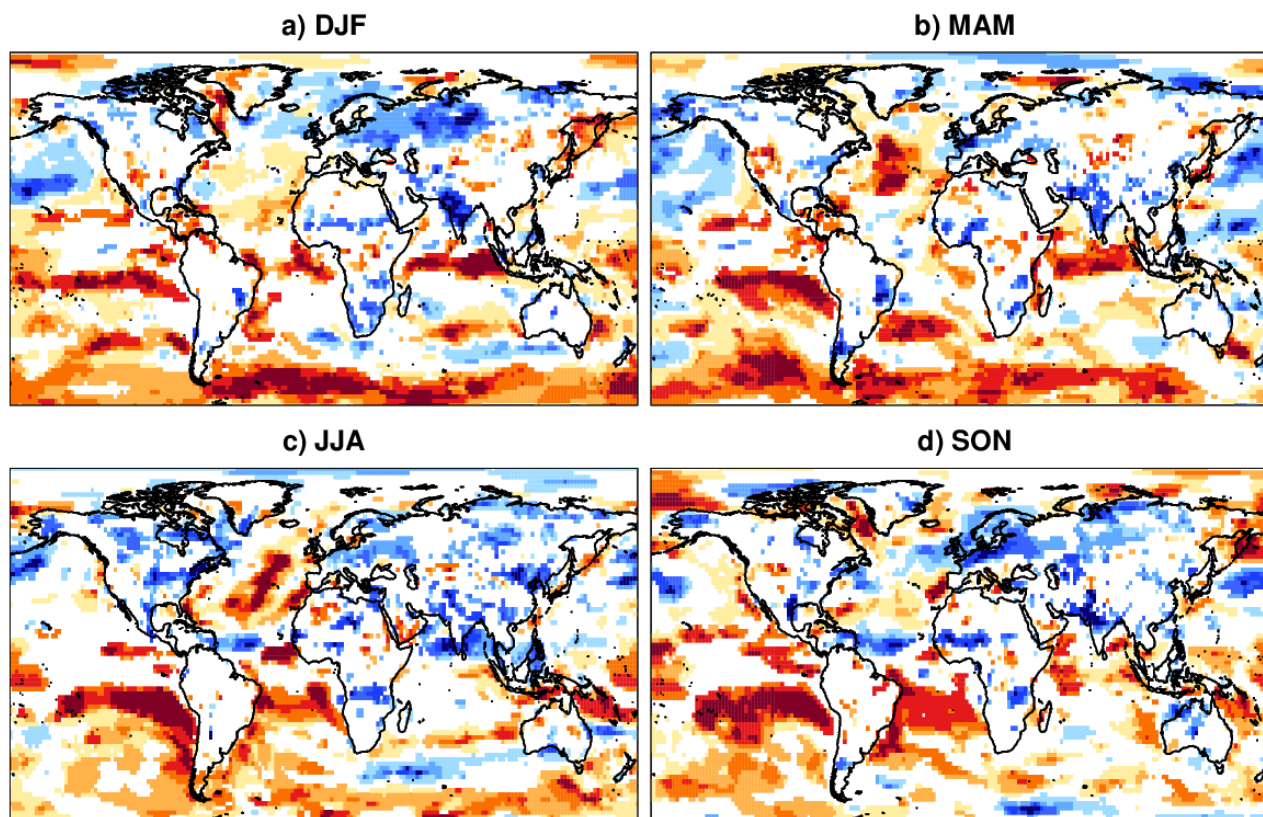
Thank you for your attention



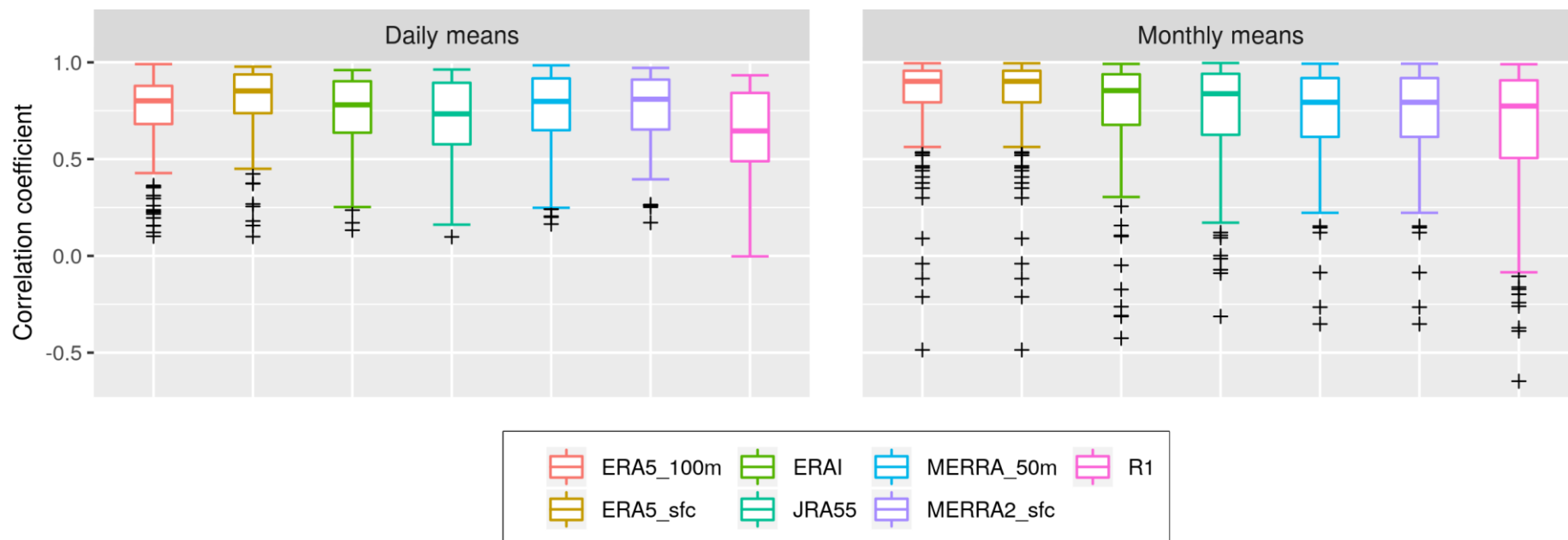
Solarwheel Limited

Gwynt y Mor wind farm, UK

- Agreements/discrepancies on wind speed trends**



- Daily and monthly correlations**



- Onshore and offshore masts classification**

Bilinear method

Daily means

R correlation coefficient

